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PATENT SPECIFICATION

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DRAWINGS ATTACHED



1 253 799

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 (72) Inventor VILGOT RAYMOND NILSSON

(54) IMPROVEMENTS IN OR RELATING TO SLUDGE CENTRIFUGES

(71) We, ALFA LAVAL AKTIEBOLAG, a Company organised and existing under the Laws of Sweden, of Postfach S,147 00, Tumba Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The present invention relates to sludge centrifuges of the kind having a rotor with a number of peripheral sludge outlets which are arranged to be closed and opened during the operation of the centrifuge.

Centrifuges of this kind generally are arranged for both partial and total emptying of the rotor. Partial emptying of the rotor means that a part of the sludge settled in the so-called sludge space of the rotor during operation is discharged through the sludge outlets, while liquid under separation is maintained within the rotor. Total emptying of the rotor means that settled sludge as well as liquid present in the rotor is discharged through the sludge outlets. When partially emptying the rotor, the supply of liquid to the latter is not normally interrupted, but when totally emptying the rotor, the supply of liquid is interrupted before the sludge outlets are opened.

During continuous operation of a sludge centrifuge of this kind, partial emptying of the rotor is used as much as possible. It is not desirable that sludge having been once separated from the liquid should be mixed again with the liquid, which will be the case when the rotor is totally emptied through the sludge outlets. When partially emptying the rotor, the sludge outlets are closed at such a stage that a quantity of settled sludge is maintained within the sludge space of the rotor, and thus no part of the liquid under separation is discharged from the rotor together with the sludge.

However, at certain times it is necessary to empty the rotor of its whole content, such as when the centrifuge has to be cleaned. Further it is sometimes necessary, owing to

different circumstances external to the centrifuge, for instance functional trouble in another part of the plant where the centrifuge is working, to stop the operation of the centrifuge for a certain period of time. Also, it is normal for the rotor to be emptied of its contents before the centrifuge is stopped.

During total emptying operations of this kind the rotor often goes out of balance. In certain cases this unbalance has been so strong, that the centrifuge in question has been damaged and has to be taken out of operation for repair. The unbalance obtained has been caused by a portion of sludge which has stuck to the walls of the rotor and not been discharged during the partial emptying operations.

As it has been impossible to indicate sludge which has adhered to the rotor like this, by means of conventional methods of so-called sludge indication, or by using the unbalance obtained by such sludge adherence to the rotor when the rotor is being emptied of its content, since the damage may already have been done by the time an indication is obtained, one has been forced to give up separating duties which involve an especially pronounced fear of adherence.

The present invention provides a method of controlling a sludge centrifuge when emptying the rotor of its contents, the rotor having a number of sludge outlets at its periphery arranged to be opened and closed during the operation of the centrifuge, comprising the steps of discharging through the sludge outlets at least a part of sludge settled in the rotor, but maintaining liquid therein, sensing the balance of the rotor, and further discharging the rotor contents at the normal operating speed of the rotor only if the rotor is balanced within predetermined limits.

By starting total emptying operations in this way the risk of machine damage is reduced. The degree of unbalance that sludge adhered to the rotor would cause while covered with liquid will not be so pro-

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nounced as it would be if the rotor were totally emptied, because of the equalizing effect of the liquid maintained in the rotor. Accordingly, instead of immediately emptying the rotor totally it is now possible, if sludge has adhered to the rotor, to reduce the speed of it or stop it completely before emptying it of its contents.

The rotor may be gradually emptied of sludge and liquid in this way, while the balance of the rotor is being sensed. Alternatively the rotor may be emptied step by step of sludge and liquid in order that the equipment necessary for performing the above method will differ as little as possible from existing sludge centrifuge equipment of this kind.

Normally, when the rotor is to be emptied entirely, the supply of liquid to the rotor is stopped, before the opening of the sludge outlets, but in case of exceptionally severe circumstances it is possible to stop the liquid supply to the rotor after a part or all of the sludge not adhering to the rotor has been discharged through the sludge outlets. Then, owing to the presence of a somewhat larger amount of liquid in the rotor, a possible uneven distribution of sludge adhered to the rotor cannot have such a pronounced effect on the rotor as if a smaller amount of liquid were present therein.

The invention also includes a sludge centrifuge for performing the described method. One form of sludge centrifuge according to the invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Figure 1 shows a portion of a sludge centrifuge of the kind here in question, and Figure 2 shows schematically a flow chart of an arrangement for controlling the emptying of the sludge centrifuge.

In Figure 1, the reference numeral 1 designates a centrifugal separator built up by two portions which are held together by means of a lock ring 2. In the rotor wall sludge outlet openings 3 are arranged to be opened and closed in a manner known per se during the operation of the centrifuge by means of a valve piston means 4. Inlet and outlet for an operating liquid for the control of said valve piston means are shown at 4a and 4b, respectively. The rotor is supported and arranged to be driven by a hollow shaft 5, through the central channel of which liquid to be separated is supplied to the separating chamber of the rotor. Liquid enters this separating chamber via the lower edge of a distributor 6. Sludge is separated out and settles at 7, while purified liquid is directed through a plate set 8 to the centre of the rotor and thence leaves via an overflow outlet 9. Numeral 10 designates a pipe being a part of a so-called sludge indicating means which is not described here in detail.

In Figure 2 numeral 11 designates a sludge centrifuge having a rotor of the kind shown in Figure 1. Through a conduit 12 liquid to be separated is led into the centrifuge 11, while purified liquid leaves the centrifuge through a conduit 13. Sludge separated from the liquid leaves the centrifuge through a conduit 14.

On the centrifuge 11 is attached means 15 arranged to sense vibrations arising owing to the rotor 1 being out of balance. Means of this kind are known per se and need not be described in detail. The means 15 is connected through a connection 16 to a control unit 17 arranged to control the operation of the sludge centrifuge. The control unit controls a valve 19 in the inlet conduit 12 of the centrifuge for liquid to be separated through a connection 18, and controls a valve 21 in a supply conduit 22 for operating liquid through a connection 20. The conduit 22 opens at 4a (see Figure 1). By stopping the flow of operating liquid to the centrifuge for a given length of time, the control unit 17 may provide for either partial or total emptying of the rotor 1 according to a predetermined programme.

When, according to the predetermined programme, the rotor 1 is to be emptied totally, the following happens:—The supply of liquid to the rotor through the conduit 12 is stopped by means of the valve 19. Then during a very short period of time the supply of operating liquid through the conduit 22 is stopped by means of the valve 21. Simultaneously the connection between the vibration sensing means 15 and the control unit 17 is temporarily broken. Owing to the interruption of the operating liquid supply the valve piston means 4 moves quickly downwards, but will return immediately, to its position shown in the drawing, when the supply of operating liquid is resumed. During the short period of time when the sludge outlets 3 of the rotor are open, sludge 7 and a quantity of liquid pass out therethrough. The liquid level in the rotor, which initially was situated at A, moves to C. Immediately after the closure of the sludge outlets 3 the connection between the vibration sensing means 15 and the control unit 17 is re-established. If now a portion of the sludge 7 in the rotor has adhered to the rotor wall and thus has not left through the sludge outlets 3 during the described operation, this sludge portion will cause an unbalance of the rotor which is sensed as heavy vibrations by the means 15. Then a signal is given by the means 15 through the connection 16 to the control unit 17, which latter will stop the planned total emptying operation. This break may lead to an alarm signal leaving the control unit 17, or some suitable corrective operations being performed. Such operations may be, for instance, that the speed of the rotor is reduced to a speed at

which a continued total emptying of the rotor is possible without any risk of machine damage, after which the rotor is stopped entirely in order to be freed manually from the sludge adhered to the rotor in the sludge space. Alternatively the rotor may be stopped entirely without having been emptied. If, however, when the liquid level within the rotor is situated at C, the means 15 is not sensing any particular vibrations, the control unit allows the total emptying of the rotor directly, while it is rotating at its normal speed of operation.

The above described method of operation may be used in cases when the adherence of sludge is not expected to be very pronounced. If, however, the settled sludge is of a kind which very easily adheres to the rotor wall and perhaps has much greater density than the purified liquid, it may be desirable to start a total emptying operation by discharging only a part of the settled sludge. The free liquid surface in the rotor then will be moved only to a level B, before the discharge operation is interrupted and the sensing means senses whether the rotor is out of balance. For the sake of safety small quantities of the rotor content then may be discharged intermittently, so that the free liquid surface in the rotor will move to the positions C and D, before the rotor is emptied entirely. If the means 15, at any time when the liquid surface is situated at the said levels, is sensing pronounced vibrations, a signal is given to the control unit 17 which, for instance in the way described above, prevents total emptying of the rotor at its normal speed of operation.

WHAT WE CLAIM IS:—

1. A method of controlling a sludge centrifuge when emptying the rotor of its contents, the rotor having a number of sludge outlets at its periphery arranged to be opened and closed during the operation of the centrifuge, comprising the steps of discharging through the sludge outlets at least a part of sludge settled in the rotor, but maintaining liquid therein, sensing the balance of the rotor, and further discharging the rotor contents at the normal operating speed of the rotor only if the rotor is balanced within predetermined limits.

2. A method according to claim 1, wherein the rotor is gradually emptied of sludge and liquid while the balance of the rotor is sensed.

3. A method according to claim 2, wherein the rotor is emptied of sludge and liquid step by step.

4. A method according to claim 3, wherein the balance of the rotor is sensed only between dischargings of sludge and/or liquid from the rotor.

5. A method according to any of the preceding claims, wherein the liquid is also discharged through the sludge outlets.

6. A method according to any of the preceding claims, wherein the supply of liquid to the rotor is stopped before any sludge is discharged through the sludge outlets.

7. A method according to any one of claims 1 to 5, wherein the supply of liquid to the rotor is not stopped until a portion or all of the sludge, which has not adhered to the rotor, has been discharged through the sludge outlets.

8. A method of controlling a sludge centrifuge when emptying the rotor of its contents substantially as herein described.

9. A sludge centrifuge arranged to perform a method according to any one of the preceding claims comprising a rotor having a number of sludge outlets at its periphery, which are arranged to be opened and closed during the operation of the centrifuge for the discharge of sludge, control means arranged to actuate the sludge outlets when the rotor is to be emptied of its contents, such that at least a part of the sludge settled in the rotor is discharged while liquid is maintained therein, and sensing means arranged to sense the balance of the rotor, and control the further discharging of the rotor contents.

10. A sludge centrifuge according to claim 9, wherein the control means is arranged, when the rotor is to be emptied of its contents to actuate the sludge outlets such that the rotor is emptied in several steps, the sensing means being arranged to sense the rotor balance between each discharging step.

11. A sludge centrifuge arranged to perform a method according to any one of claims 1 to 8, substantially as herein described with reference to the accompanying drawings.

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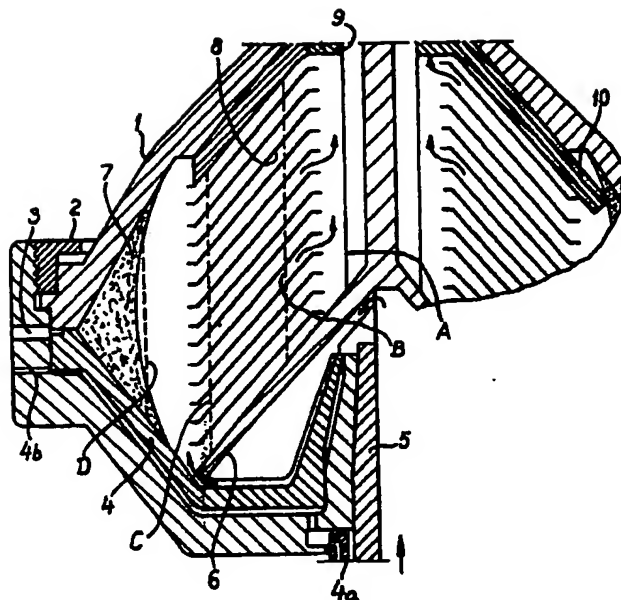


Fig. 1

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COMPLETE SPECIFICATION

2 SHEETS

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Sheet 2

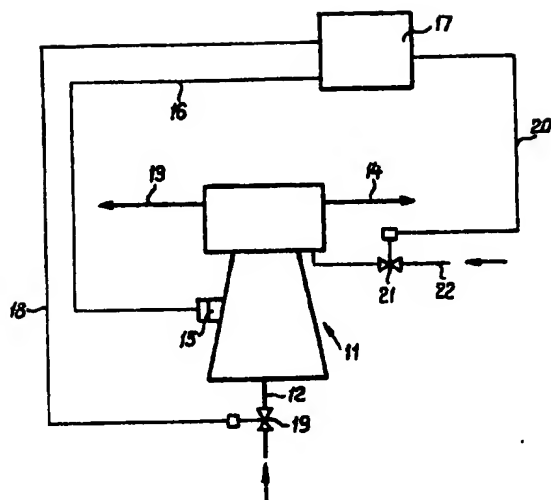


Fig. 2